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# Responsible Vouchering in Turtle Research: An Introduction and Recommendations

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**Abstract. – Voucher specimens are critical to the advancement of research efforts on turtles, and by association, for conservation efforts associated with this group. This paper addresses the importance of voucher specimens and provides recommendations for responsible practices associated with voucher specimens. For the purposes of this paper, a voucher specimen is defined as a biological specimen, the primary function of which is to provide verification for the taxonomic identification assigned to an animal and any eventual published or reported scientific investigations associated with it. A traditional voucher specimen for a turtle consists of a fluid-preserved specimen or a complete skeleton and its associated data appropriately preserved for permanent storage and housed in a curated collection for posterity. Although not optimal, a non-traditional voucher may also provide verification for taxonomic identification and may include image or acoustic data, eggs or eggshells, or tissue samples. Examples are given of when a traditional voucher specimen deposited in a curated collection is recommended and when alternatives to the traditional voucher specimen, such as an *e*-voucher, may be used. In addition, a worldwide survey of curated collections holding turtles was conducted and the percentage of turtles represented in reptile collections is reported.**

**Key Words. – Reptilia; Testudines; turtles; traditional voucher specimen; non-traditional voucher specimen; *e*-voucher; curated collection; tissue sample**

Turtles[1] (Order Testudines) comprise just 3.7% of all named extant reptile species (307 turtle species out of 8240 total named reptiles; Uetz and Hallermann, 2007). Extant turtles are a highly distinctive group characterized by several features, including a secondarily anapsid skull, a shell that encloses both limb girdles, an external ear supported by a large, semicircular quadrate, and toothless jaws (Ernst and Barbour, 1989; Meylan, 2001). Approximately 40% of all extant turtle species are considered threatened and listed as either Critically Endangered, Endangered, or Vulnerable by the IUCN - World Conservation Union (Khamsi, 2004; IUCN, 2007). Key threats to turtles include direct mortality by collection for food, traditional medicine, and the pet trade, in addition to incidental mortality caused by road kills, habitat loss, and the introduction of predators and competitors (van Dijk et al., 2000; Khamsi, 2004).

Species boundaries play a crucial role in the prioritization of conservation efforts for turtle taxa (Avise, 1989; Remsen, 1995; Reynolds et al., 1996; Sites and Crandall, 1997; Soltis and Gitzendanner, 1999; DeSalle and Amato, 2004). Taxonomists use many different characters, including morphological and/or molecular, in the delineation of species and/or subspecies (Wiley, 1978; Frost and Hillis, 1990; de Queiroz, 1998, 1999). Over time, species concepts, criteria, and the characters used to distinguish species may change. It is therefore not uncommon that a species description may be reviewed and challenged over the years (e.g., Parham et al. 2001). Type specimens for new species and voucher specimens from published studies provide researchers with the option to use alternative methods or advancing technologies to re-examine previous descriptions or conclusions. Voucher specimens also allow independent verification of the taxonomic identification of individuals used to test the hypotheses generated in the study (Reynolds et al., 1996). It is for these reasons that voucher specimens are critical to the advancement of research efforts on turtles, and by association, for conservation efforts associated with this group.

This paper will address the importance of voucher specimens and provide recommendations for responsible practices associated with voucher specimens.

## The Definition of a Voucher Specimen

A voucher specimen has previously been defined in the literature by authors representing various biological disciplines:

[1] For the purposes of this paper, a turtle refers to all species included in the Order Testudines, including turtles, tortoises, and terrapins.